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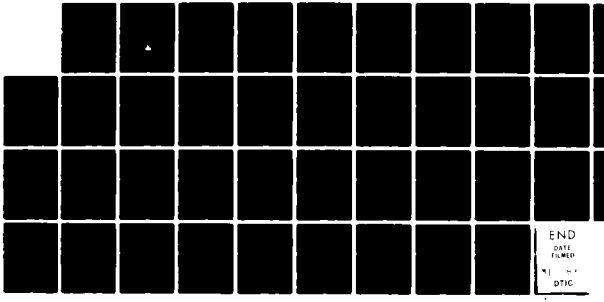

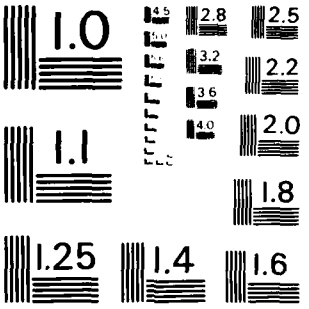

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A MODEL OF HOUSING CHOICE BEHAVIOR FOR MILITARY FAMILIES

MAJOR FRANKLIN L. GERTCHER

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Department of English
U.S. Air Force Academy
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This paper provides a multinomial logit model which explains the effects of the current Department of Defense (DOD) housing program on military family housing choice behavior in a three sector housing market. The model was applied to data on military families assigned to installations within the continental United States. The paper concludes with a presentation of empirical results and a brief discussion of the possibilities for further research.

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Franklin L. Gertcer

Department of Economics
United States Air Force Academy
Colorado

ABSTRACT

This paper provides a multinomial logit model which explains the effects of the current Department of Defense (DOD) housing program on military family housing choice behavior in a three sector housing market. The model was applied to data on military families assigned to installations within the continental United States. The paper concludes with a presentation of empirical results and a brief discussion of the possibilities for further research.

I. INTRODUCTION

Since World War II, Congress and the Department of Defense (DOD) have devoted a good deal of attention to the demand for housing by military families who live on or adjacent to military installations within the continental United States.[1] In light of this general expression of concern

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[1]Public Law 345, August 11, 1955, which amends sections 401 through 409, Title VIII of the National Housing Act, June 27, 1934, is an expression of Congressional concern. Other studies include: Breese, C., Kilingenmeier, R., et al., The Impact of Large Installations on Nearby Areas: Accelerated Urban Growth, in association with the Bureau of Urban Research, Princeton University, Sage Publications Inc., Beverly Hills, CA., 1965 and The Impact of Military Base Closings, prepared by the University of Kansas for the United States Arms Control and Disarmament Agency, 1960.

and the more pragmatic interest in ways of influencing military family housing consumption behavior consistent with certain government housing policies, it is striking how little is known about the way in which individual military families choose between housing alternatives.

The purpose of this paper is to explain military family housing choice in a three-sector housing market: home ownership, private rental, or military rental housing. Consistent with this purpose, a multinomial logit model is presented which expresses the probability of choice of home ownership, private rental, or military rental housing as a function of the respective sectoral differences in the values for the independent variables in the following table.

TABLE 1

INDEPENDENT VARIABLES IN THE DEMAND FUNCTION

x_1 Monthly cost of housing services (absolute amount)

x_2 Distance to work

x_3 Number of bedrooms

y_1 Income (Regular Military Compensation)[2]

y_2 Number of persons in family

y_3 Expected period of dwelling unit occupancy

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[2]Regular Military Compensation (RMC) is defined as the sum of basic pay, quarters and subsistence allowance and the tax advantage of the tax exempt status of the allowances. The tax advantage is calculated by determining the amount of additional taxable earnings required to pay the tax and still be left with the same take-home pay.

The theoretical model was applied to 1,822 observations of individual military family housing choice.[3] These data represent a statistically representative sample of military families assigned to military installations within the continental United States.

II. THEORY

Consider the housing choice problem faced by a military family that seeks to obtain a dwelling unit in one of three possible housing sectors. Essentially, it was assumed that a family will choose the dwelling unit that maximizes its utility as conditioned by the family socioeconomic characteristics (y_i) listed in Table 1. It was also assumed that the dwelling unit attributes (x_i) listed in Table 1 are part of each family's utility function. It follows then, that the choice of a dwelling unit from a particular sector may be explained in terms of the differences in dwelling unit attributes across sectors and the differences in socioeconomic characteristics across families.

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[3] The logit technique for explaining consumer choice behavior was originally demonstrated by Daniel McFadden (1973). See D. McFadden, "Conditional Logit Analysis of Qualitative Choice Behavior," in Zarembka, ed. Frontiers in Econometrics, New York, Academic Press, 1973.

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It was also assumed that all families considered in this study have freedom of choice between three alternative housing sectors. The model does not apply to families who are not eligible for military family housing, and it does not apply to installations which coerce military families to occupy military rental units.[4]

Finally, it was assumed that the differences in waiting periods for dwelling unit occupancy represent a negligible factor in the choice between housing sectors. This assumption was based on the following empirical evidence. First, in the vast majority of cases, military families make the housing sector choice only when they move from one installation to another. When a family arrives at a new installation, temporary housing is normally available. Further, the DOD provides extra temporary allowances and payments which cover temporary living expenses. Thus, most families have adequate time to search for housing and adequate funds to wait until a dwelling unit in the desired sector becomes available. Also note however, that waiting lists for the military rental option are common at most military installations. At the four installations considered later in this study, the waiting period to obtain a

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[4] DOD Instruction 4165.44 dated 28 January 1975 provides overall guidance for determining eligibility criteria for military rental housing for all military service departments. Air Force Regulation 90-1 implements DOD 4165.44 in the Air Force. Similar regulations have been published by the Army and Navy. DOD Instruction 4165.44 insures that eligibility criteria are consistent for all three military service departments.

Air Force Regulation 90-1 outlines the criteria for eligibility for military rental housing in the Air Force. Essentially, Air Force members in pay grades E-4 or above, with at least two years active duty or an

military rental dwelling unit ranged from 0 to 90 days from the time of arrival on station in 1978, with a mean period of about 56 days. The mean periods for private rental and owner occupancy were eight days and 78 days, respectively. However, for the reasons cited above, these differences do not significantly affect housing choice between sectors. This opinion is also held by responsible officials at the installations included in this study.

Now consider the variables which explain the probabilities of choice with respect to housing sector. Conceivably, all dwelling unit attributes which have differences across sectors and all characteristics which have differences across families could influence the probability of choice associated with a given sector. Both attributes and characteristics were included as explanatory variables. Table 1 identifies only those variables which proved to have significant explanatory power in our empirical applications. Of course, those variables not included in Table 1 were permitted to enter the model through an error term.

In the context of our model, x_1 is the uniform monthly cost, or imputed rent, to a family of the housing services yielded by a dwelling unit. The measurement of x_1 poses different problems in each of our three sectors.

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obligation of six years, who are eligible for Basic Allowance for Quarters (BAQ) at the dependent rate, are also eligible for military rental housing. This includes female members who have dependents in their own right. Air Force members are assigned housing units according to rank and family composition.

Let us begin with military rental. Families who reside in military rental housing forfeit their Basic Allowance for Quarters (BAQ) in exchange for military rental housing services. All other costs, including utilities and repairs, are paid by the DOD. Thus, for the purpose of this paper, the forfeited BAQ represents the complete monthly rental payment experienced by each family that consumes military rental housing services. This forfeited BAQ is directly observable from the data.

Now consider the imputed rent for a private rental dwelling unit. The following table identifies the cash flow experienced by a military family that consumes private rental housing service.

TABLE 2

COSTS ASSOCIATED WITH PRIVATE RENTAL

Monthly rent payment[5]

Average monthly utility payment

Damage deposit

Renter's insurance

These and other miscellaneous payments were totaled and averaged on a monthly basis by each private renter family included in the sample of military families. Thus, the imputed rents for private rental dwelling units can be taken directly from the data.

Now consider the imputed rent for an owner-occupied dwelling unit. Table 3 identifies the cash flow experienced by a family that selects home

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[5] It was assumed that monthly rental payments are relatively stable for a given family over a normal tour length at a given military installation. We base this assumption on the fact that most military families in private rental housing obtain one to two year renewable leases, and that in most cases, increases in rent at lease renewal tend to be either zero or very small. See the DOD annual housing survey summaries for the years 1975-78 for further details.

ownership. This cash flow was used to calculate an imputed uniform monthly rent. With the exception of selling price and federal income tax, the amounts in the following table are self-explanatory.[6]

TABLE 3

CASH FLOW ASSOCIATED WITH HOME OWNERSHIP

1. Purchase price of home
2. Foregone interest on down payment
3. Closing costs
4. Term of loan (normally 30 years)
5. Monthly principal and interest payment
6. Average monthly insurance payment
7. Monthly property tax payment
8. Average monthly utility payment
9. Expected period of occupancy
10. Federal income tax benefit
11. Expected selling price
12. Realtor commission for selling home (normally six percent of the selling price)
13. Incidental selling expenses

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[6]The data available for this study do not permit explicit consideration of capital gains tax due to the sale of a home. Implicitly, it was assumed that any expected capital gains tax is included as an adjustment to the selling price. It is of interest to note that a capital gains tax need not be paid if a home owner sells a home and buys another within 18 months of the sale, provided the purchase price of the new home equals or exceeds the selling price of the old home. For military families, the 18 month time limit may be extended upon request up to four years, depending on active duty commitments. Refer to the Uniformed Services Almanac (1978), L. Sharff and S. Gordon, ed. Also, note that Table 3 includes "expected period of occupancy." Thus, y_3 is incorporated into the calculation of x_1. However, we cannot assume that it is entirely incorporated. This statement is supported by the results shown in the correlation matrix of the initial computer runs with the logit model. Therefore y_3 was included as a separate variable in Table 1.

Since estimates of expected selling price may reasonably vary, it is worthwhile to expressly recognize the propensity to be biased in estimating the future selling price of a home. Table 4 portrays forecast sets which were made based on past regional median selling prices of existing single family homes for four regions within the continental United States.[7]

TABLE 4

EXPECTED AVERAGE ANNUAL SELLING PRICE APPRECIATION FOR SINGLE FAMILY HOMES

Region	Average Annual Rate (1979 - 1988) G1	G2	G3
Northeast	5%	7%	8%
Northcentral	6%	8%	9%
West	7%	9%	10%
South	6%	8%	9%

[7] The time series data for selling price forecasts were taken from annual issues of the Statistical Abstract of the U.S., U.S. Department of Commerce. A review of the data available for this study shows that the monthly payments associated with utilities, maintenance, property tax, and insurance are individually small compared to the total monthly payments made by home owners (on the order of 15, 12, 10, and 5 percent, respectively). Changes in these relatively small cash flows that are consistent in magnitude with past changes are not expected to have a significant effect on housing choice behavior. Forecasts of expected annual changes in these payments were therefore not made.

The definitions for the above forecast sets are as follows:

Group 1 (G1): Within the range of realism, make those forecasts which are pessimistic with respect to owning a home.

Group 2 (G2): Make those forecasts which reflect the most realistic expectations with respect to owning a home.[8]

Group 3 (G3): Within the range of realism, make those forecasts which are optimistic with respect to owning a home.

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[8]The following simple predictive model was used to make G2 forecasts of the expected median selling price:

$$X_t = Ae^{\beta t}$$

where X_t is the median regional selling price of existing single family homes in year t. Data included observations for years 1968 through 1978. An average annual appreciation rate over the next decade was calculated for each region based on the slope of the function $X_t = Ae^{\beta t}$ evaluated for the years 1979-88. Obviously, the above predictive model "explains" nothing, since appreciation rates are actually a function of certain fundamental housing market variables. Basically, it was assumed that the fundamental variables will continue to interact over the next decade in the same way as they did during the past decade, and that time is a satisfactory proxy for predictive purposes over the relatively short term of ten years. In any case, it is certainly plausible that prospective home buyers will continue to expect that homes will appreciate in the future as they have in the past, and that expected selling price is a relevant variable in housing choice behavior. G1 and G3 estimates of appreciation rates are based on an analysis of variance from G2 values of X_t. As a final note, other models were tried for predictive purposes, including an Almon lag model - a moving average model, and a simple linear least squares model. However, it was concluded that the model used is preferable for technical and theoretical reasons.

Now consider the federal income tax benefit for home owners.[9] If home owners were taxed like other investors, they would have to report as income the gross imputed rent on their homes. Like other investors, home owners would be allowed to deduct maintenance, depreciation, interest, and property taxes as expenses incurred in earning this income. Net rent, which is the difference between gross imputed rent and the above expenses, would be included in taxable income. However, home owners do not have to include gross imputed rent on their tax returns, although they are permitted to deduct mortage interest and property taxes. Thus, taxable income for home owners is understated by the sum of net rent, mortgage interest, and property taxes.

Following Rosen, Laidler, Aaron, et al., the federal income tax benefit to home owners was estimated in the following manner:[10]

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[9] More than 50 percent of the states have some provision for either the total or partial exemption of military income from state income taxes. Even in those states where military income is not exempt, the tax amounts actually paid by military families are generally quite small; therefore the state tax benefits due to home ownership are considered negligible in this study. Refer to All States Income Tax Guide, (1978), Office of the Staff Judge Advocate, Headquarters U.S. Air Force, Washington, D.C., and Sharff, L. and Gordon, S. Uniformed Services Almanac, op. cit.

[10] If the home owner were taxed like other investors, he would have to report as income the gross imputed rent on his house. Like other investors, he would be allowed deductions for maintenance, depreciation, interest, and property taxes as expenses incurred in earning this income. The differences between gross imputed rent and these expenses, net rent, would be included in taxable income. However, the home owner does not have to include gross imputed rent on his tax return, although he is permitted deductions for mortgage interest and property taxes. Thus, taxable income for home owners is understated by the sum of net rent, mortgage interest, and property taxes. The higher one's marginal tax rate, the greater the tax saving associated with this reduction in taxable income, see Rosen, H.S. "Housing Decisions and the U.S. Income Tax," Journal of Public Economics 11 (1979), 1-23, for futher details.

$$f = \frac{m(rV_t + T)}{rV_t + T + D + M}, \qquad (1)$$

where f = Federal tax benefit

m = Marginal tax rate [11]

V_t = Balance on home loan, year t

r = Mortgage interest rate

T = Property tax (effective rate x V_t)

D = Depreciation (straight-line from purchase price)

M = Maintenance

The cost components for each observation of home ownership must be converted to a uniform series to be used as an imputed rent comparable to the rents for military and private rental observations. This conversion can be accomplished by using standard techniques associated with the time

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[11] The marginal tax rate was computed in a manner suggested by M. Feldstein and C. Clodfelter in their paper, "Tax Incentives and Charitable Contributions in the United States," Journal of Public Economics 5 (1976), 1-26. However, I made the additional assumptions that: (1) all home onwers in our sample itemized deductions, and (2) total itemized deductions equal the standard deduction plus the mortgage interest rate and the property tax. Obviously, total itemized deductions need only exceed the standard deduction to make itemizing advantageous to the taxpayer. Given that it is generally advantageous for a home owner to itemize, we have two possible deviant cases: (1) If the itemized deductions other than mortgage interest and property tax are less than the standard dedcution, our computed marginal tax rate would be too high. (2) If the reverse situation occurred, the computed marginal tax rate would be too low. The method used assumed that these possible deviant cases either balance out in the aggregate or are negligible.

value of money. The discount rate is assumed to be an opportunity cost of the use of money assets, and is therefore defined simply as the mortgage interest rate at the time of housing choice. Specifically, the cash flow for a home over the period of ownership can be converted to a uniform monthly series with the following equation.[12]

$$x_{1(h)} = \sum_{h=1}^{m} I_h \left[\frac{r(1+r)^n}{(1+r)^n - 1}\right] - \left[\sum_{j=1}^{n/12} T_j(1 + 12r)^{-j}\right]$$

$$\left[\frac{r(1+r)^n}{(1+r)^n - 1}\right] + \sum_{k=1}^{q} M_k - \sum_{i=1}^{p} S_i \left[\frac{r}{(1+r)^n - 1}\right] \qquad (2)$$

where (1) $x_{1(h)}$ is the uniform monthly imputed rent associated with home ownership,

(2) r is the monthly discount rate,

(3) n is the number of months of ownership,

(4) I_h = initial cash amounts at time zero,

(5) T_j = annual cash amounts due to income and property taxes,

(6) M_k = monthly cash amounts, and

(7) S_i = cash amounts at the time the home is sold.

(8) Note that cash outflows are positive and receipts are negative.

Now consider cost differences across sectors. Consistent with conventional economic theory, the relevant cost was defined as the difference between the value of x_1 for the selected dwelling unit and the value of x_1 for a rejected dwelling unit in an alternative sector. Thus,

[12] See E. L. Grant, and W. G., Ireson, Principles of Engineering Economy, Ronald Press Co., New York, 1970, for details.

$(X_{1i} - X_{1j})$ is the relevant cost of the selected dwelling unit relative to a rejected dwelling unit in an alternative sector. The second subscript indicates housing sector, where j is the unit in the rejected sector.

In addition to the imputed rent for a selected dwelling unit, X_{1j} values are needed which correspond to each family's rejected dwelling unit in each of the alternative housing sectors. For a family in a rental dwelling unit, the cost associated with a rejected owner-occupied dwelling unit was estimated as the mean of actual monthly payments for families with the same socioeconomic characteristics who actually selected home ownership.[13] Means were calculated for families according to field

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[13]The use of total monthly payment as the cost of rejected home ownership assumes that renters perceive a higher cost for home ownership than the imputed rent perceived by home owners. There are at least two reasonable rationalizations for this assumption. First, our data shows that over 80 percent of private renters and over 66 percent of military renters are junior enlisted families with relatively low military incomes. Low income families are likely to be more concerned with meeting the higher total monthly payment than with the imputed rent, which incorporates the long-term tax benefit and capital gain. Home owners, on the other hand, tend to have higher military incomes and are better able to meet the higher monthly payment, with the expectation that the tax benefit and the capital gain will result in a lower uniform imputed monthly rent over the long term. The second rationalization begins with Table 4 and the associated discussion. Table 4 implies the existence of a distribution of expectations with regard to the appreciation rate of owner-occupied dwelling units. If renters tend to be pessimistic with regard to appreciation rates, they would be concentrated at the low end of the distribution. The perceived cost of rejected home ownership would therefore be higher for renters compared to the imputed rent perceived by the relatively more optimistic home owners. Urlike the first rationalization, no hard evidence is available to support this second rationalization; therefore clarification is left to further research.

To obtain the cost of rejected home ownership in terms of total

grade, company grade, senior enlisted, and junior enlisted categories at each installation included in this study. To estimate x_{1j} for a rejected private rental dwelling unit, the mean imputed rent for private rentals for each category for each installation was used. The x_{1j} for a rejected military rental dwelling unit is simply the BAQ to which each family is entitled.

Now consider x_2, the distance from a dwelling unit to the place of work for the military members of each family. For selected dwelling units, the value for distance-to-work is directly available for each observation included in this study.

However, values for x_2 were needed which correspond to the rejected dwelling unit in each of the alternative housing sectors. If comparable units for sale and for rent are available at any given distance from work, then the distance of rejected private rental (ownership) to one who chooses ownership (private rental) is identical to the observed (chosen) distance. Thus, distance does not characterize these two alternatives, except in relation to military rental.

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monthly cost, home owner data were divided into field grade, company grade, senior enlisted, and junior enlisted categories, and mean values of the actual monthly payment for home ownership were found for each category. These means were used as the values for the cost of home ownership as a rejected alternative for families in each category. Note that these categories correspond very closely to income classes, from highest (field grade) to lowest (junior enlisted). A similar procedure was used to estimate values for the cost of private rental as a rejected alternative for similar reasons. More extensive models were not considered.

Alternatively, if comparable units for sale and for rent are available at all distances, then a distinct value for the distances of the rejected private housing alternative may exist. If the real housing market conforms with the first case, the coefficient on the distance variable will simply not be significant. The second case was used, since it is more flexible. For the distance of the rejected private dwelling unit, I resorted to the data on families who have chosen private rental (ownership) and calculated a mean distance from the work center for each military rank at each installation. The value of the distance variable for rejected military rental housing is simply the distance from the geometric center of the military housing complex to the work center.

Now consider x_3, the number of bedrooms in a given dwelling unit. For dwelling units that were selected, the value for the number of bedrooms for each observation was available. However, values for x_3 which correspond to rejected dwelling units in each of the alternative housing sectors were needed. To obtain rejected values for x_3, refer to the fact that the DOD calculates a standard (median) number of bedrooms for each family size. The actual number of bedrooms for the selected housing alternative was compared to the standard which is the assumed value of the rejected alternative in each case. The discussion of variable x_1, x_2, and x_3 is now complete.

As indicated in Section I, y_1 is the income received by the military member of each family in our sample of individual family observations. This

income, or Regular Military Compensation (RMC), is defined as the sum of basic pay, quarters and subsistence allowance, and the tax advantage to the tax exempt status of the allowances. The tax advantage is calculated by determining the amount of additional taxable earnings required to pay the tax and still be left with the same take-home income. Thus, y_1 does not include income from other than DOD sources.[14] Values for Y_2, the number of persons in each family, were based on the entire sample of individual family observations.

The values for y_3, the expected period of dwelling unit occupancy, were a mix of directly observed and average values. The expected periods of dwelling unit occupancy (y_3) were directly available for all observations of home owners; however, y_3 values were estimated for families who selected private rental and military rental dwelling units. Essentially, average (mean) values were obtained for the actual period of occupancy for renters who departed each installation included in this study during the year 1978. For each rank and installation, it was assumed that no significant difference existed between the expected period of occupancy for private and military renters and the mean of actual periods of occupancy for private and military renters with the same rank who departed from these installations during 1978.

[14] An attempt was made to include a proxy for wealth in the logit model. Unfortunately, all feasible proxies showed strong correlations to y_1 when incorporated in our logit regression. In fact, the interaction between income and wealth resulted in a negative coefficient for the income variable, which is inconsistent both with economic theory and the findings of previous research. The wealth proxy was dropped from the analysis. Wealth from sources other than military income must therefore enter the model through the error term.

III. THEORETICAL MODEL

In this section, a model which can be used to statistically explain a given military family's choice of housing sector is presented. Consider the following framework.

First, home ownership, private rental, and military rental housing sectors represent mutually exclusive choices for a given family. For example, a family that chooses home ownership rejects private rental and military rental housing. Thus, the probabilities associated with selecting a dwelling unit from the alternative sectors sum to one. Given the probabilistic nature of the choice between housing sectors, there are two relevant types of models which could be used: a linear probability model or a model which incorporates a cumulative probability distribution. The rationale for choosing the latter is as follows.

When a linear probability model is used for prediction, two serious weaknesses of the model become apparent. First, the model involves the interpretation of predicted values of the dependent variable as probabilities, and predicted values outside the (0,1) range are possible. A less than satisfactory solution to this problem is to set exreme predicted values to either 0 or 1. While the estimation procedure might yield unbiased estimates, the prediction obtained from the estimation process are clearly biased. The second weakness arises because observations in a given sample may be drawn excessively from attributes whose values are associated with extreme values of choice probabilities (0 and 1), i.e., the attribute values may be bunched such that the estimated regression

line may significantly deviate from the true regression line.[15]

All the difficulties associated with the linear probability model point to the need for an alternative model specification. Since the most serious weakness arises from the fact that predictions may lie outside the (0,1) interval, it is natural to search for alternative distributional assumptions for which all predictions must lie between (0,1). This requirement suggests that the use of a cumulative probability function will provide a suitable monotonic transformation of unconstructed real independent variables to achieve a probability which ranges between (0,1).

The logit model is based on the cumulative logistical probability distribution, satisfies the transformation requirement, and is therefore theoretically superior to the linear probability model. The logit technique can easily be adapted to our problem of choice.

Let us begin with a general discussion of qualitative choice behavior. Following Lancaster's approach to the theory of utility maximization, it was assumed that a family, acting as a decision unit, can rank-order dwelling units according to preference. The family will then choose the sector which offers the dwelling unit that maximizes its utility, as conditioned by the socioeconomic characteristics listed in Table 1. Utility was assumed

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[15] See R. S. Pindyck and D. L. Rubinfeld, Econometric Models and Economic Forecasts, 1976, Chapter 8, for further details.

t · be derived from the amounts of relevant attributes inherent in each dwelling unit.[16]

Now consider a universe of conceivable housing attributes and let M be an arbitrary index set naming the elements of this universe. For each housing alternative, a row vector X of attributes x from M can be observed. Referring to the set of attributes listed in Table 1, M contains three attributes as elements: monthly cost (x_1), distance-to-work (x_2), and number of bedrooms (x_3). Each therefore includes values for x_1, x_2, and x_3.

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[16] Kelvin J. Lancaster, "A New Approach to Consumer Theory," Journal of Political Economy, April 1966, also R. H. Strotz, "The Empirical Implications of a Utility Tree," Econometrica, 27, 1959. Lancaster recognized that the utility of a commodity is no more than the utility it yields during consumption. A commodity can be represented by a "package" of attributes which are experienced by the consumer. Thus, different housing units may offer different quantities of each relevant attribute. Strotz developed a utility tree concept which grouped commodities according to function. A household is assumed to allocate its income to commodity groups such as food, education, etc., and then to commodities within each group. The household utility function can then be expressed as

$$U = U[U_1(Z_1, Z_2 \ldots Z_a), U_2(Z_{a+1}, Z_{a+2}, \ldots Z_b) \ldots]$$

where

U is the level of household utility

U_j is the level of utility from the jth commodity group, $j = 1, 2, 3, \ldots m$.

Z_i is the quantity of the ith commodity, $i = 1, 2, 3, \ldots n$.

Substitutes for commodities are found within the same groups, while independent commodities are found in separate groups. Thus, the utility derived from housing can be considered as a separate entity from the utility derived from other commodities.

Consider another vector, Y, which summarizes the socioeconomic characteristics of a given family. The vector Y is also defined as a row vector, and includes income, family size, etc. (See Table 1). Thus, a family housing choice situation is also defined by a vector Y of observable socioeconomic characteristics in addition to our list of housing alternatives, each with an observable vector of attributes. Referring to the set of characteristics listed in Table 1, Y has three characteristics as elements: y_1, y_2, and y_3.

A military family was assumed to have to choose a dwelling unit from one housing sector from among three alternative sectors identified by a vector of indices N = (1, 2, 3). Thus, the set of row vectors of the observable housing attributes available to a family can be denoted $X = (X_1, X_2, X_3)$, where each X_1 represents a row vector of values for the attributes from M. The vector observable data for a housing choice situation for a single family is then (X,Y), or with subscripts identified (X_1, X_2, X_3, Y).

Following the theory set forth in McFadden's seminal paper, it can be shown that for a vector Y of socioeconomic characteristics for a given family, the natural logarithms of the ratio of the probabilities of one housing sector compared to another is simply the difference between the corresponding elements in the respective vectors X_j of housing attributes for the best preferred dwelling unit in each sector.[17] However, to obtain elasticities of the probability of choice with respect to the variation in

[17] McFadden, op. cit.

elements the vector Y, observations of housing choice by k families with different values for the elements in Y were included. Thus, for k families, vectors, Y_k, k = 1, 2, ... n exist.

With respect to the probabilities of choice, equation (3) can be expressed as follows:

$$\log \frac{P_1}{P_2} = \alpha_{12} + \beta_{13} (X_1 - X_2) + \delta_{12} Y$$

$$\log \frac{P_1}{P_3} = \alpha_{13} + \beta_{13} (X_1 - X_3) + \delta_{13} Y$$

$$\log \frac{P_2}{P_3} = \alpha_{23} + \beta_{23} (X_2 - X_3) + \delta_{23} Y \qquad (3)$$

where the β and δ are (3 x 1) row vectors and the X and Y are (1 x 3) column vectors.[18]

Each equation presumes that the logarithm of the odds of one choice relative to a second choice is a linear fuction of the differences between the elements of the attribute vector X and the characteristic vector Y. These odds are dependent on the odds associated with the remaining two equations only in the sense that the system must be constrained to that the sum of the individual probability equals 1. It is unnecessary to estimate each of the three equations separately, if the parameters of the

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[18] As I discussed earlier, the differences $(X_1 - X_2)$, $(X_1 - X_3)$, and $(X_2 - X_3)$ represent the differences between the respective attributes of the selected and the rejected housing sectors for a given family. The δ_{ij} are obtained by measuring the differences between the respective socio-economic characteristics across families.

first two equations are known, the third equation need not be estimated.[19]

To conclude this section, the multinomial logit model is consistent with a theory of utility maximization by military families, with unobservable factors entering the housing utility calculus. These factors may be due to "stochastic" choice by families arising from lack of complete information on housing alternatives, or may be due to the inability of the econometrician to measure all of the variables considered by a sample of military families from a given population.

IV. EMPIRICAL MODEL

To approximate the theoretical model expressed in equation (3) refer to a computer program developed by John G. Cragg at the University of British Columbia.[20] Cragg's program produces maximum likelihood estimates of the parameters associated with the independent variables in equation (4). Also, the program provides asymptotic standard errors, t-ratios, correlation coefficients, and finally some summary and goodness-of-fit statistics.

As applied to the model of housing choice, Cragg's program converts to the following empirical equation:

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[19] Pindyck and Rubenfeld, op. cit.

[20] See John G. Cragg, Programs for Multiple Probit and Logit Analysis, unpublished paper, Department of Economics, University of British Columbia.

$$\log \frac{P_1}{P_m} = \hat{\gamma}_m + \hat{\beta}_1 (x_{12} - x_{1m})$$

$$+ \hat{\beta}_2(x_{22} - x_{2m}) + \hat{\beta}_3(x_{32} - x_{3m})$$

$$+ \hat{\alpha}_3(x_{32} - x_{3m}) + \hat{\delta}_1 y_1$$

$$+ \hat{\delta}_2 y_2 + \hat{\delta}_3 y_3 + \mu \qquad (4)$$

where $i = 1, 2$; $m = 2, 3$, the $\hat{\gamma}$ are the estimated coefficients associated with the differences between the respective attributes of the selected and the rejected housing sectors; the $\hat{\delta}$ are the estimated coefficients associated with the respective socioeconomic characteristics across families; and μ is the error term. Finally, note that the Cragg program employes the Goldfeld, Quandt, and Trotter method (1966) to solve the *maximum likelihood equations*.[21]

Now consider the expected signs of the coefficients for relevant cost. Essentially, a negative relationship between P_1/P_2 and the cost difference $(x_{11} - x_{12})$ was expected. If $(x_{11} - x_{12})$ is positive, then as the difference gets smaller, the probability of home ownership will increase. On the other hand, if $(x_{11} - x_{12})$ is negative, then the probability of home ownership will increase. On the other hand, if $(x_{11} - x_{12})$ is negative, then the probability of home ownership will continue to increase as the difference becomes more negative. Similar relationships were expected between P_1/P_3 and $(x_{11} - x_{13})$ and P_2/P_3 and $(x_{12} - x_{13})$ and P_2/P_3 and $(x_{12} - x_{13})$.

[21] Cragg, op. cit.

For distance-to-work, a negative relationship between P_1/P_2 and $(x_{21} - x_{22})$ was expected, since a reduction in the travel cost associated with home ownership relative to private rental would increase the probability of ownership. A negative relationship was expected between P_1/P_3 and $(x_{21} - x_{23})$ and P_2/P_3 and $(x_{22} - x_{23})$, since military rental dwelling units are invariably closer to the work center, and as distance increases, private housing becomes less attractive in terms of increased travel costs between the dwelling unit and the work center.

For number-of-bedrooms, a positive relationship between P_1/P_2 and $(x_{31} - x_{32})$ was expected, since an increase in the number of bedrooms for an owned dwelling unit relative to the number of bedrooms for a private rental unit would tend to make home ownership more attractive. For P_1/P_3, a positive coefficient was expected for the number of bedrooms. Again, an increase in the number of bedrooms for an owned dwelling unit relative to military rental would tend to make home ownership more attractive. For P_2/P_3, a negative coefficient was expected for the number of bedrooms. Further, a strong correlation between the cost difference and number-of-bedrooms was expected. Essentially, the monthly cost of a private rental unit, both to the landlord and subsequently to the renter, is directly related to the amount of floor space. This relationship is especially true for multi-family dwellings. However, the monthly cost of a military rental unit is constant for a given family, regardless of the number of bedrooms. Thus, as the number of bedrooms increases, the military rental unit becomes relatively more attractive in terms of the

strongly correlated monthly cost.

Now consider military income (y_1), the first of the socioeconomic variables. Following Li, et al., a clear indication that the probability of home ownership increases with respect to y_1 was expected. However, P_2/P_3 would tend to decrease with respect to y_1, because newer and larger military dwelling units are generally reserved for senior enlisted and field grade families at the installations included in this study. There is a direct relationship between rank and military income; therefore, as military income increases, so does the incentive to obtain military rental housing. In the absence of capital gain and tax benefit incentives, private rental would therefore appear to be the least attractive alternative for higher income military families.

The following framework was necessary for a test of whether the probability of home ownership increases or decreases as a function of family size, holding income constant. Initially, as family size increases with income held constant, Li hypothesized that large families substitute housing service for non-housing good.[22] However, as family size continues to increase with income held constant, the largest families substitute

[22] M. M. Li, "A Logit Model of Home Ownership," Econometrica, Volume 45, No. 5 (July 1977).

non-housing goods for housing service. Li then analyzed a representative sample of private rental and owner occupied dwelling units and concluded that owner occupied units provide more housing service in terms of floor space per dollar spent than private rentals. Thus, with income held constant, Li expected the conditional probability of home ownership to initially rise with increases in family size but to eventually decline for the largest families. Li's empirical results tended to support his hypothesis.

Given Li's plausible explanation of the relationship between housing choice and family size, it was hypothesized that the conditional probability of home ownership compared to private rental tends to increase with military family size, holding income constant. A leveling off effect for the largest families, and possibly a decrease, was expected.

However, military families also have the military rental option. As previously explained and Li's work tended to support, larger families initially substitute housing service for non-housing goods. Further, a larger family may well demand more housing service than provided by the standard military dwelling unit to which they are nominally entitled. Thus, the probability of choosing a private dwelling unit was expected to increase as family size increased. However, a leveling off effect and possibly a decrease in this probability for the largest families was also expected for reasons analogous to Li's explanation concerning the probability of home ownership.

Now consider the expected signs for the coefficient of y_3, the

expected period of occupancy, relative to our conditional probabilities. Essentially, both P_1/P_2 and P_1/P_3 were expected to increase as a function of Y_3 because the expected capital gain and the tax benefit associated with home ownership increases over time, making home ownership relatively more attractive over the long run. However, there is no a priori reason to suppose the P_2/P_3 will either increase or decrease as a function of Y_3. It was therefore expected that Y_3 would not be significant in this case.

V. EMPIRICAL RESULTS

Table 5 includes the estimated logit coefficients and certain goodness-of-fit statistics for the probability of home ownership compared to private rental (P_1/P_2). The results in Table 5 are interpreted as follows. To begin, note that the coefficients for relevant cost, difference in number-of-bedrooms, income, and expected period of occupancy are significant and have the expected signs. However, the coefficients for the difference in distance-to-work and for family size were not significant.

The lack of significance for the difference in distance-to-work

TABLE 5

PROBABILITY OF HOME OWNERSHIP COMPARED
TO PRIVATE RENTAL

Dependent Variable	Logit Coefficient	Independent Variable	T-Ratio
P_1/P_2	-0.9611	$(x_{11} - x_{12})$	-8.8539
	0.0161	$(x_{21} - x_{22})$	1.0279
	1.9618	$(x_{31} - x_{32})$	9.1942
	0.7238	y_1	3.4139
	-0.0643	y_2	0.8347
	0.0325	y_3	3.3274
	-0.6850	Constant	-1.2597

Pseudo R-Square = .5160

Pseudo R-Square for Model = .7404

Likelihood Ratio Test = 822.12 with 6 D.F.

coefficient merits further explanation. Essentially, it is possible that travel cost-to-work is the relevant variable rather than distance-to-work.[23] Car pools, bus lines, and other modes of travel may effectively change travel costs so that distance is relatively unimportant. However, confirmation or denial of this possibility is left to further research.

At this point, it is useful to briefly compare the signs of our income and cost difference coefficients for the probability of home ownership compared to private rental equation with the signs of the income and price coefficients obtained by Ohls with his probit switching equation.[24] Essentially, the signs of these two coefficients are the same, respectively, for both models. No further comparisions can be made due to the theoretical differences between logit and probit and the differences in model specification. Also, goodness-of-fit statistics cannot be compared, since Ohls does not present such statistics in his paper.

Table 6 provides mean and standard deviation statistics for the independent variables in our home ownership compared to private rental logit run. Of special interest are the mean values for the monthly cost difference (measured in dollars), and the mean values for the distance differences (measured in miles).

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[23] The opportunity cost of time spent in travel was implicitly included as part of travel cost-to-work. Refer to Edwin S. Mills, Urban Economics, Scott, Foresman and Co., 1972, pp. 85-88. Also see the empirical studies referenced by Mills with regard to the choice of transportation mode for travel-to-work.

[24] See C. James Ohls, "A Cross Section Study of the Demand Function for Housing and the Policy Implications of Resolds." (PhD Dissertation) University of Pennsylvania, 1971.

TABLE 6

VARIABLE STATISTICS FOR HOME OWNERSHIP TO PRIVATE RENTAL COMPARISON

Variable	Mean	Standard Deviation
Home owner cost difference	-46.85	113.60
Private rental cost difference	-31.88	73.24
Home owner distance difference	1.43	.73
Private rental distance difference	-.59	3.37
Home owner bedroom difference	.06	.96
Private rental bedroom difference	-.06	.96
Income (RMC)	18430.00	7949.00
Number of persons in family	3.71	2.13
Expected period of occupancy	46.26	17.28

Table 7 contains our logit coefficients and goodness-of-fit statistics for the probability of home ownership compared to military rental (P_1/P_3). The coefficients presented in Table 7 are interpreted as follows. First, with the exception of distance, all coefficients are significant and have the expected signs. Again, refer to Mills and to the possibility of specification error with regard to the distance variable. Also, the negative coefficient for the family size variable is not conclusive with regard to the test of the probability of home ownership as a function of family size, since no restrictions were placed on the variation of income across families. A discussion of this test of the probability of home ownership with regard to family size is presented later in this paper.

TABLE 7

PROBABILITY OF HOME OWNERSHIP COMPARED TO MILITARY RENTAL

Dependent Variable	Logit Coefficient	Independent Variable	T-Ratio
P_1/P_3	-2.2423	$(x_{11} - x_{13})$	-19.2048
	0.0824	$(x_{21} - x_{23})$	3.7084
	0.8545	$(x_{31} - x_{33})$	4.9057
	0.4682	y_1	2.8612
	-0.1280	y_2	-3.1523
	0.0204	y_3	2.2918
	0.9575	Constant	2.2191

Pseudo R-Square = 0.5895

Pseudo R-Square for Model = 0.7876

Likelihood Ratio Test = 1331.04 with 6 D.F.

Table 8 provides mean and standard deviation statistics for the independent variables in the home ownership compared to military rental logit run.

TABLE 8

VARIABLE STATISTICS FOR HOME OWNERSHIP TO MILITARY RENTAL COMPARISON

Variable	Mean	Standard Deviation
Home owner cost difference	-1.30	78.15
Military renter cost difference	-108.20	130.05
Home owner distance difference	6.06	7.90
Military renter distance difference	-4.44	5.19
Home owner bedroom difference	0.32	.66
Military renter bedroom difference	-.32	.67
Income (RMC)	19700.00	7258.00
Number of persons in family	4.04	1.92
Expected period of occupancy	47.22	15.15

Table 9 presents the logit coefficients and goodness-of-fit statistics for the probability of private rental compared to military rental (P_2/P_3). The cost difference coefficient is significant and has the expected sign. The difference in distance-to-work coefficient is not significant for reasons postulated earlier. The difference in number-of-bedrooms coefficient is significant, has the expected sign, and has a strong positive correlation (.469) to the cost difference.

TABLE 9

PROBABILITY OF PRIVATE RENTAL
COMPARED TO MILITARY RENTAL

Dependent Variable	Logit Coefficient	Independent Variable	T-Ratio
P_2/P_3	-0.5154	$(x_{12} - x_{13})$	-3.4818
	-0.0141	$(x_{22} - x_{23})$	-0.8004
	-1.2850	$(x_{32} - x_{33})$	-7.3724
	-0.6238	y_1	-2.8752
	-0.4196	y_2	-4.1425
	-0.0290	y_3	2.2384
	2.8002	Constant	4.0865

Pseudo R-Square = .3839

Pseudo R-Square for Model = .5380

Likelihood Ratio Test = 489.21 with 6 D.F.

Table 10 provides mean and standard deviation statistics for the independent variables in our private rental compared to military rental logit run. Of special interest is the fact that the mean cost difference for private renters is a positive number.

TABLE 10

VARIABLE STATISTICS FOR PRIVATE RENTAL TO MILITARY RENTAL COMPARISON

Variable	Mean	Standard Deviation
Private renter cost difference	24.27	54.38
Military renter cost difference	-111.70	115.20
Private renter distance difference	2.40	3.80
Military renter distance difference	-6.54	5.10
Private renter bedroom difference	-.20	.86
Military renter bedroom difference	.20	.86
Income (RMC)	16080.00	6989.00
Number of persons in family	3.66	1.31
Expected period of occupancy	47.42	3.67

A further inspection of the data provided some interesting evidence with regard to the characteristics of families that live in private rental and military rental housing. Essentially, it was found that approximately 80 percent of the private renters in our representative sample were junior enlisted families. On the other hand, 23 percent of the home owners and 66 percent of the military renters were junior enlisted. The percent of junior enlisted families in military rental is consistent with the respective percentage of the total population at the installations included in this study. However, junior enlisted families are under-represented in the home owner sector and over-represented in the private renter sector.

There are at least two possible explanations consistent with

the above evidence. First, it is likely that many junior enlisted families experience wealth and budget constraints which limit their entry in the home ownership sector and are effectively limited to the private rental and the military rental sectors.[25] Given the constraints to home ownership, it is possible that they pay a premium to live in private rental rather than military rental housing because they perceive a positive difference in the amount of housing service provided by private rental dwelling units compared to the military rental dwelling unit offered. This explanation would incorporate possible perceived negative externalities associated with living on the installation in a military environment. A second possible explanation includes wealth and budget constraints to home ownership but involves a different explanation of the private rental premium relative to military rental. Essentially, it is possible that junior enlisted families experience effective barriers to the military rental sector which are not experienced by families with higher ranking military members. For example, junior enlisted families that are technically eligible for military rental housing may lack seniority on waiting lists or may have relatively less information and experience with regard to obtaining the military rental option. Confirmation or denial of these two and other possible explanations are left to further research.

[25] Many studies have shown that the cash flow problem represents a substantial barrier to home ownership for lower income, less wealthy families. For example, see G. H. Miller, "The Affordability of Ownership in the 1970s," Economic Review, Federal Bank of Kansas City, September-October 1980.

Let us discuss expectations with regard to the analysis of the probability of home ownership as a function of family size, holding income constant. Consider military families in the private market. Consistent with the findings of Li, the conditional probability of home ownership was expected to increase and then decline as family size increased, holding income constant.[26] However, military families also have the military rental option. Essentially, the probability of choosing a private dwelling unit was expected to increase and then decline as family size increased because larger families are able to obtain larger dwelling units in the private market compared to the standard unit offered by the DOD. Finally, a leveling-off and possibly a decrease was expected in the probability of choosing a private dwelling unit for the largest families for reasons analogous to Li's explanation concerning the probability of home ownership with respect to private rental.

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[26]M. M. Li, "A Logit Model of Home Ownership, Econometrica, Vol 45, No. 5 (July 1977); also see John M. Quigley, "Housing Demand in the Short Run: An Analysis of Polytomous Choice," Explorations in Economic Research 3 (1), Occasional Papers of the National Bureau (Winter 1976), for additional evidence. Essentially, Quigley has shown that holding income constant, larger families are less likely to choose multi-family units and are more likely to choose common-wall and single detached units. Further, Quigley has shown that for income classes beginning with $5,000-$7,000, larger families have a higher probability of consuming progressively larger, effective lot sizes. An inspection of the private housing data available for our study shows that multi-family dwelling units are overwhelmingly private rental units. Also, common-wall units (including duplexes and townhouses) have a greater proportion of owner-occupancy compared to multi-family units, and single detached dwelling units are predominately owner-occupied. Given that larger families tend to choose common-wall and single detached units, the probability of home ownership would tend to increase with family size.

The results of the analysis are presented in Table 11 and 12 and Figures 1 through 6. Table 11 presents the conditional probability of home ownership given that a family has selected private housing. Table 12 provides the conditional probability of home ownership given that a family may select either home ownership, private rental, or military rental housing. Each table shows the respective probabilities as a function of family size for six income classes. The probabilities from Table 11 and 12 were graphed in Figures 1 through 6, where P(1/1,2) represents the probability of home ownership (1) given the choice of private housing (1,2), and P(1/1,2,3) represents the probability of home ownership given the choice of home ownership (1), private rental (2), or military rental housing (3). The findings with regard to P(1/1,2) are consistent with Li, and the findings with regard to P(1/1,2,3) clearly indicate the effect of the military rental option on the choice of housing sector as a function of family size.

TABLE 11

CONDITIONAL PROBABILITY OF HOME OWNERSHIP
GIVEN THAT A FAMILY CHOOSES
PRIVATE HOUSING P(1/1,2)

Income Class	Family Size 2	3-4	5	6+
$ 7,000 - 9,999	.192	.388	.615	.750
10,000 - 14,999	.643	.846	.818	.704
15,000 - 19,999	.600	.815	1.00	1.00
20,000 - 24,999	.895	.876	1.00	.920
25,000 - 29,999	.900	.956	1.00	.762
30,000 - 37,000	.929	.971	.941	1.00

TABLE 12

PROBABILITY OF HOME OWNERSHIP
P(1/1,2,3)

Income Class	Family Size 2	3-4	5	6+
$ 7,000 - 9,999	.171	.271	.258	.333
10,000 - 14,999	.353	.381	.371	.358
15,000 - 19,999	.300	.256	.394	.278
20,000 - 24,999	.723	.579	.619	.619
25,000 - 29,999	.642	.685	.673	.516
30,000 - 37,000	.591	.614	.658	.794

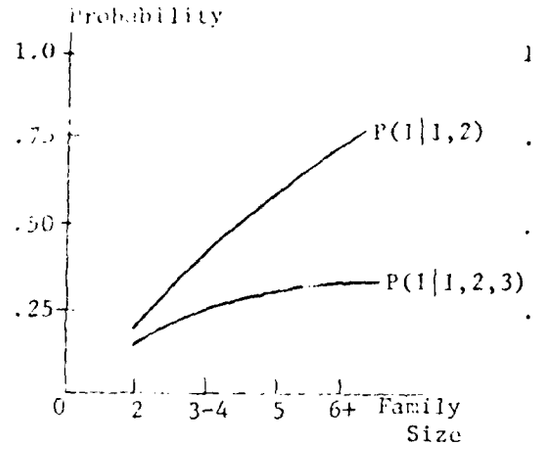

Figure 1. 7,000-9,999 Income

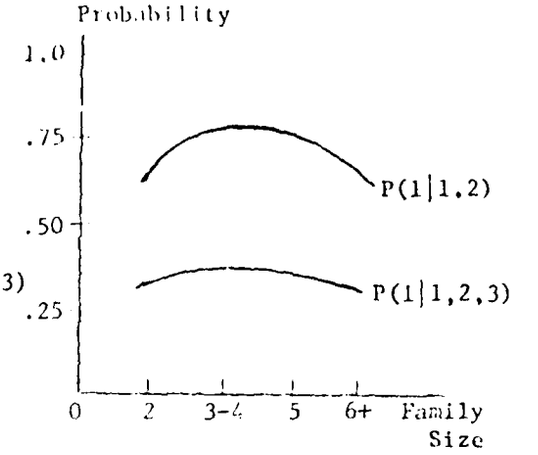

Figure 2. 10,000-14,999 Income

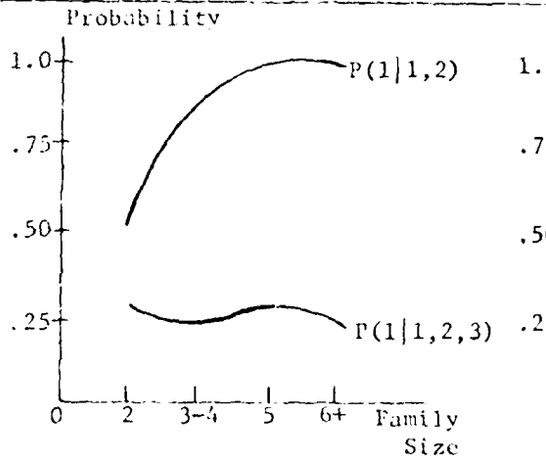

Figure 3. 15,000-19,999 Income

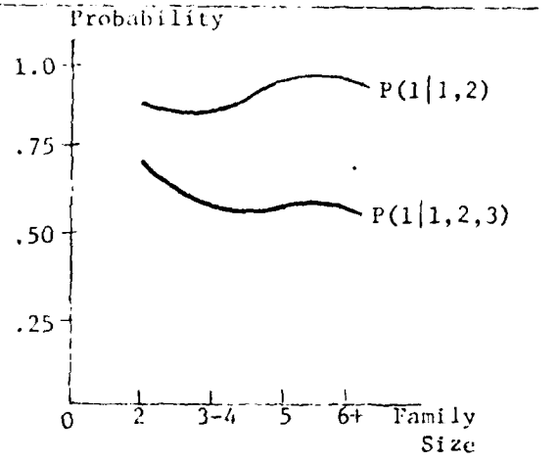

Figure 4. 20,000-24,999 Income

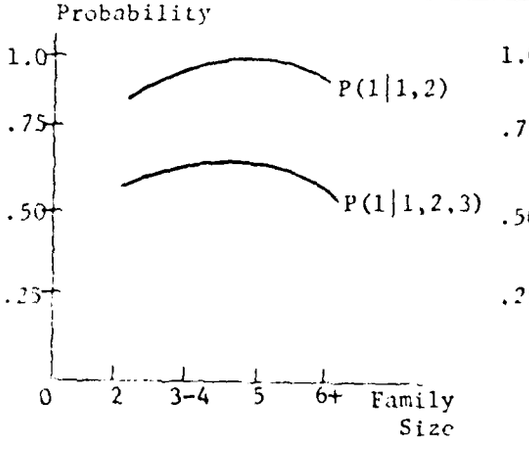

Figure 5. 25,000-29,999 Income

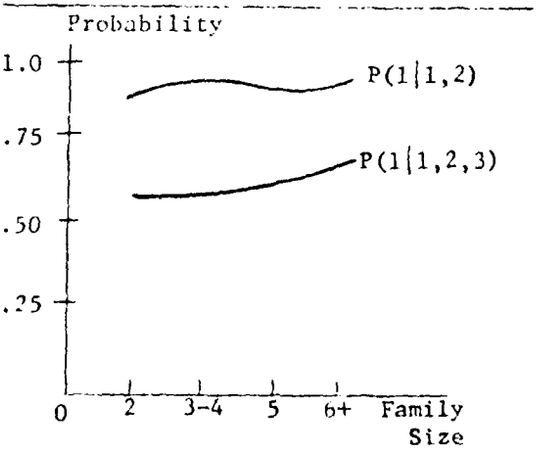

Figure 6. 30,000-37,000 Income

Now consider the analysis of P(2/2,3), the conditional probability of choosing private rental, given that a family has chosen to rent. Essentially, we stated in Chapter III that we expected P(2/2.3) to increase and then decrease as family size increased, holding income constant. The empirical results are presented in the following table and in Figures 7 through 12.

TABLE 13

CONDITIONAL PROBABILITY OF PRIVATE RENTAL GIVEN THAT A FAMILY CHOOSES TO RENT P(2/2,3)

Income Class	Family Size 2	3-4	5	6+
$ 7,000 - 9,999	.871	.508	.217	.167
10,000 - 14,999	.303	.112	.131	.235
15,000 - 19,999	.286	.078	0	0
20,000 - 24,999	.692	.195	0	.125
25,000 - 29,999	.200	.100	0	.333
30,000 - 37,000	.111	.048	.048	0

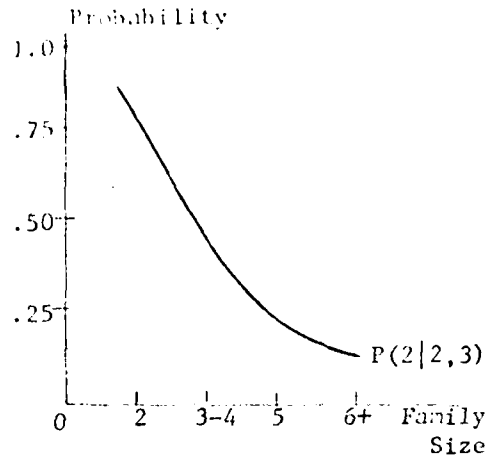

Figure 7. 7,000-9,999 Income

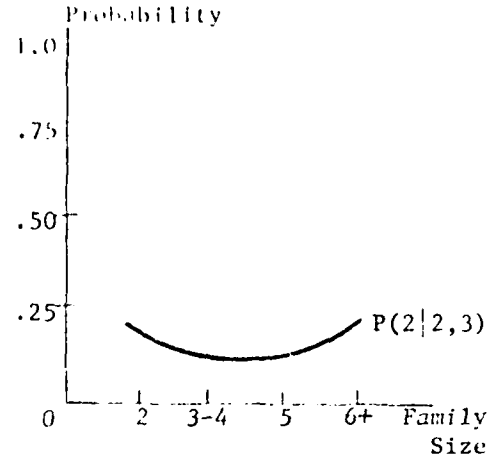

Figure 8. 10,000-14,999 Income

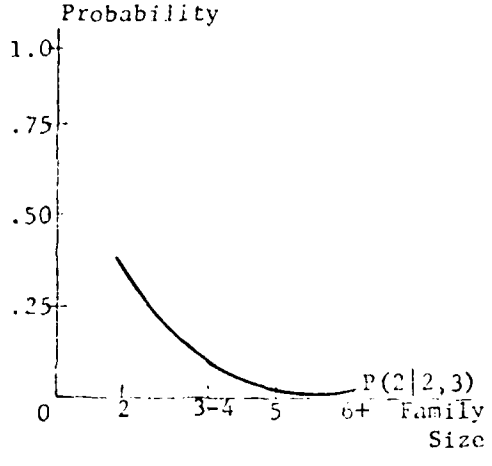

Figure 9. 15,000-19,999 Income

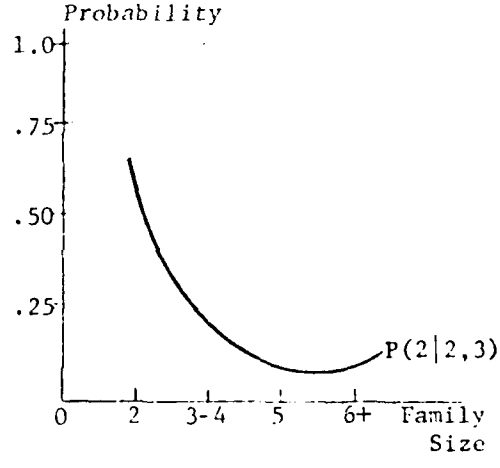

Figure 10. 20,000-24,999 Income

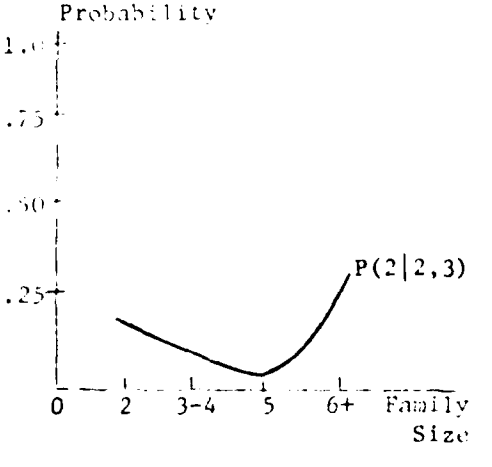

Figure 11. 25,000-29,999 Income

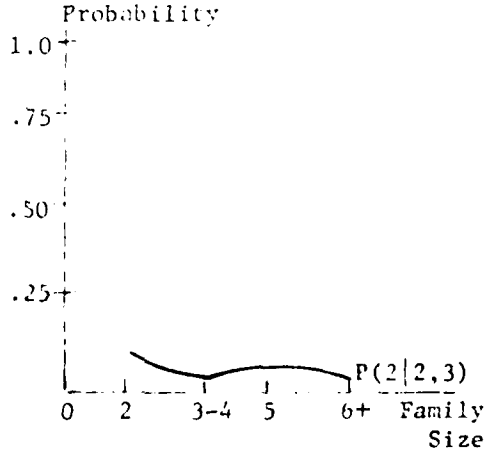

Figure 12. 30,000-37,000 Income

Clearly, as family size increases for a given income class, the conditional probability of private rental, given that a family rents, drops rapidly then increases slightly. This result is not consistent with the expectation presented earlier.

The following explanation is offered. First, as stated earlier, the monthly cost of private rental dwelling units increases directly with the amount of floor space. Second, military rental dwelling units have a standard monthly rent (forfeited BAQ) which is independent of the amount of floor space offered. If military rental dwelling units are relatively large to begin with and if military families become more concerned with floor space as family size increases, then military families would tend to select military rental dwelling units with more floor space per rental dollar compared to private rental. Under these conditions, a decrease in the conditional probability of private rental as family size increases would occur.[27] Other possible explanations are left to further research.

VII. SUMMARY AND CONCLUSIONS

As stated in the introduction, the purpose of this paper was to first explain the effects of the current DOD housing program on military family housing consumption behavior. Consistent with this purpose,

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[27] Given that I observed a consistent decrease in P(2/2,3) for all income classes, I infer that the DOD provides larger dwelling units. A detailed confirmation or denial of this inference is beyond the scope of this paper. However, the opinion that it is a correct inference is shared by the responsible base housing officials at the installations included in this study.

a logit model was presented which expressed the probability of choice of home ownership, private rental, or military rental as a function of the respective differences in monthly cost, distance-to-work, and number of bedrooms across housing sectors, and income (RMC), number of persons in family, and expected period of dwelling unit occupancy across families. The empirical application of the logit model resulted in the expected coefficient signs and, with the exceptions explained in the previous section, all coefficients were significant.

There are a number of possible applications for this model. For example, it provides a means for predicting the probabilities of housing choice given the observed values of the independent variables. These probabilities can be used to assess the impact of large scale personnel transfers on local private housing markets and on available military rental housing. Also, the estimated elasticities can be used to predict changes in the probabilities of choice caused by government induced changes in the values associated with one or more of the independent variables. Other possible applications include predicting the impact of changes in military rental housing eligibility criteria and assessing the impact of changes in local housing market conditions. However, as indicated earlier, these applications are left to further research.

The models are generally applicable to any military installation within the Continental United States, given that the assumptions of the model are met. However, other researchers are cautioned in insure that the freedom of choice assumption is indeed valid before applying the model. In those cases where the assumptions of the model are not valid,

note that logit model theory as presented in this paper provides an excellent framework with regard to probabilities of housing sector choice and that the theory can be applied to develop other estimated models which fit particular situations. Finally, note that certain refinements to the logit model would improve its explanatory power for policy applications. Specifically, the empirical work presented in this paper was limited by the availability of data for certain variables. The values for the expected period of occupancy of private and military renters were estimated and the data for income did not include possible income from other than military sources. The accuracy of the coefficients would be improved if these data were directly available. However, a change in the signs of our estimated coefficients would be unlikely.

As is apparent from statements throughout this paper, this study represents only the beginning of a much-needed comprehensive analysis of the current DOD housing program. Aside from the issues of quantity and quality of housing service available to military families, note that in fiscal year 1978, DOD family housing and assistance programs involved a total obligation authority of over 1.5 billion dollars. The current DOD housing program is obviously big business; the taxpayers deserve an efficient and effective program consistent with the intent of Congress.[28]

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[28]Public Law 345, op. cit.

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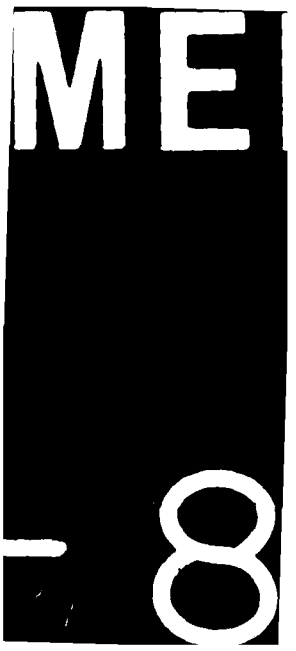
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